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ABSTRACT

A newly developed instructional system for introductory college geography links the computer with the geographer's most traditional and essential tool--the thematic map. The use of the computer overcomes the logistical and mechanical problems associated with the teaching of thematic mapping to large groups and helps the students to focus upon the cardinal issues of decision making. The instructional system consists of a series of modules (data banks, mapping programs, and a transgeneration program) linked by a main program. The data banks contain dey variables for a geographic area and data packages needed to contruct symbol, choropleth, and isopleth maps. CMAP and SYMAP are the mapping programs. The transgeneration program uses the same approach as the Biomedical (BMD) system. A Burroughs B-3500 computer is used. Students select a theme and variables and input data to the computer. Individual student information is stored on a disc until maps for the entire class are ready to be run at one time. Interviews with students and examination performance indicate the system is successful. (PB)

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COMPUTER AIDED INSTRUCTION IN TEACHING THEMATIC MAPPING

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In the realm of undergraduate instruction, geographers are just beginning to view the computer as a tool which complements the instructor and other teaching aids. For most geography majors, exposure to computers either does not occur until their graduate training or until they take a quantitative methods or model construction course late in their undergraduate work. Very few non-geography majors are exposed to computers when taking geography courses. This paper presents an instructional system, for an introductory geography course, which links the computer with the geographer's most traditional and most essential tool: the thematic map.

Class Structure

Geography 100, Introductory Geography, is taken mainly by freshmen and juniors who have transferred from two year colleges. For many of these students, Geography 100 represents their first formal course in geography and one of their major interests in taking the course is to learn more about maps. A series of lectures is presented on how thematic maps are used to synthesize and to communicate information and ideas. Employing concepts presented in lecture, the student uses the laboratory-discussion periods to develop maps via the computer.

Problem Area

Before utilizing the computer, the teaching of thematic mapping to a large introductory geography class created many logistic and mechanical problems that obscured the most important element in developing thematic maps: the decision making process. The instructor faced the problem of either permitting too much latitude by allowing students to find their own data to be mapped and their own base maps, or being too rigid by providing students with a limited selection of data and other materials. The first approach gave students considerable freedom in the selection of topics to be mapped, but created numerous difficulties for the instructor since the data usually selected by students were inappropriate or too complex. The second approach reduced the instructor's problems but limited the topics available to the students, which often caused frustration and boredom.

The major mechanical problem was the actual preparation of the map. This stage in the map's development required considerable time and some drafting experience, both of which many students did not have. These limitations allowed students to make only one, or possibly two maps. Since so much of their time and effort was spent at this stage of development, the importance of decision making became secondary, and one of the instructor's major goals was not met.

Objective

The objective of this instructional system is to introduce students to thematic mapping and the decision making processes associated with it. To meet this objective, the aforementioned logistic and mechanical problems were eliminated by developing an instructional computer system. Now students are learning about thematic mapping and their major concern is with the decision making processes.

Organization of Computer System

The instructional system consists of a series of modules (data banks, mapping programs, and a transgeneration program) linked by a main program. (See Figure 1) The data banks contain data on a certain number of key variables within a particular geographic area, and also contain the data packages needed to construct the different types of maps of the geographic area. Three types of maps are available at the present time: the symbol map, the choropleth map, and the isopleth map. CMAP written by Morton W. Scripter and SYMAP written by Harvard's Laboratory for Computer Graphics are the two mapping programs employed in this unit. CMAP has been modified by the author to accept case values and parameter values in the

EM 011 377

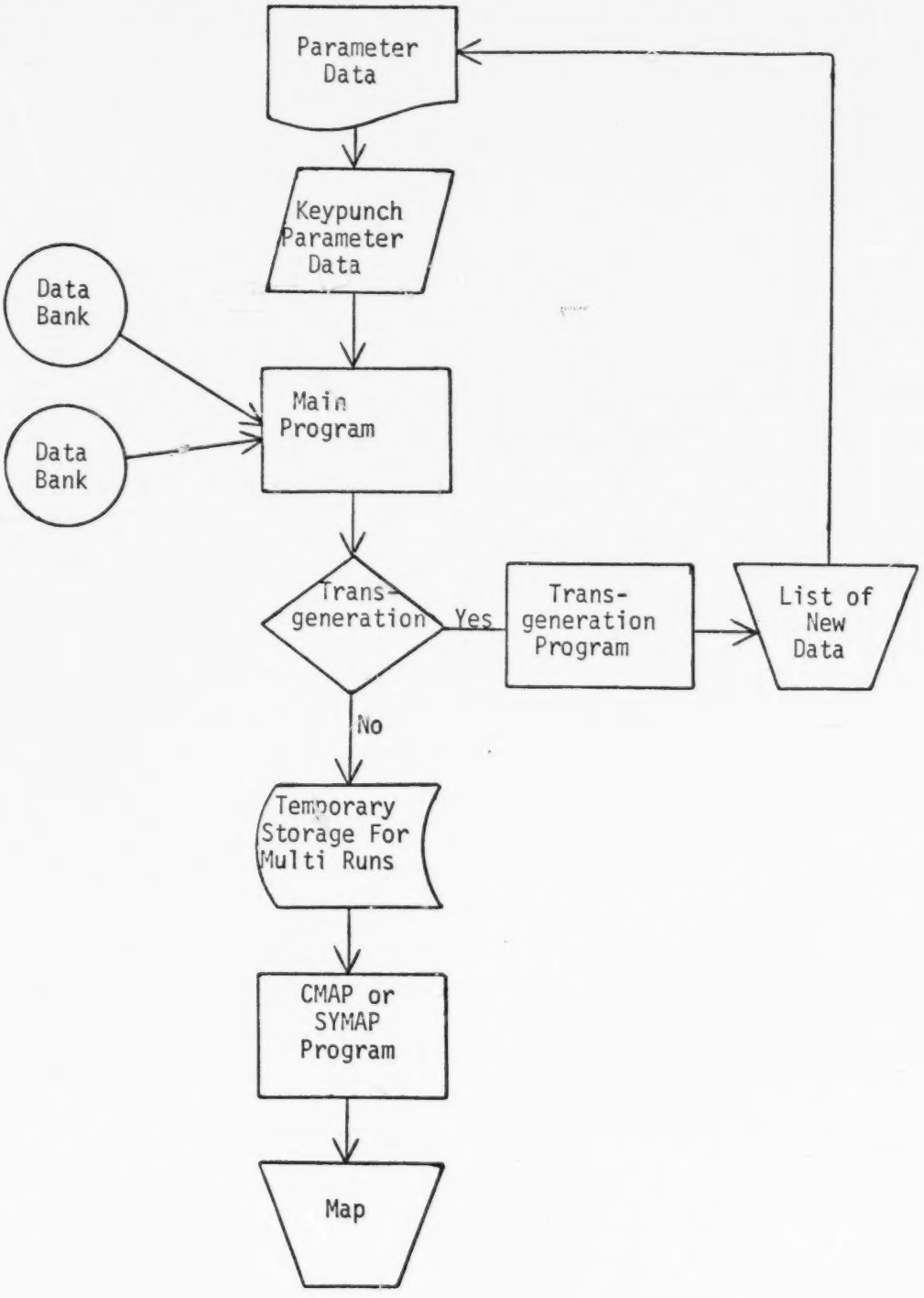

Figure 1. Flow Chart of Computer Mapping System

same format used by SYMAP. This common input format permits easy transfer between the two programs. CMAP is used mainly to make the symbol and choropleth maps, while SYMAP produces the isopleth maps. SYMAP is also a backup program for making symbol and choropleth maps, but since it consumes a considerable amount of time, CMAP is much more practical to use. The transgeneration program is designed along the same approach as the Biomedical (BMD) transgeneration system. This program allows new data to be formed from data already located in a data bank. Therefore, this program permits the databanks to be kept small in terms of the number of variables to be maintained, but provides for the possibility of having data on hundreds of different variables.

Once a student has made his decisions about a map, they are recorded on a single page form and given to the instructor who has the information keypunched. Experienced student keypunchers are able to punch this information rather fast and with a high degree of accuracy. To instruct each student on how to keypunch his own information would create major logistic problems due to a limited number of keypunches. Experience has also shown that novice student keypunchers create numerous errors and become easily frustrated with the entire project. After the parameters are keypunched and read in, the main program scans the appropriate data bank for the map data package and the data to be mapped. This information is temporarily stored on a disk until the necessary information for all the maps to be run at one time is ready; then the information is read from the disk to one of the two mapping programs.

If a student elects to form new data by the transgeneration program, an extra step occurs in the system. Before a student is able to make meaningful decisions in the creation of his map, he must examine the data; therefore, a list of the new data is prepared for him by the computer. After examining the data and making his decisions, he submits his parameter information for making the map.

This instructional system is operational on a Burroughts B-3500 computer with a memory size of 90000 bytes and with two tape drives and a disk storage unit. This configuration is common to most four year colleges and some two year colleges within the State University of New York. Thus, it requires little effort to transfer this instructional system, or any other software system to the other units within SUNY.

Thematic Mapping

Thematic maps are developed by geographers to synthesize and to communicate information and ideas. Therefore, except for reference type maps, students need to be exposed to the way maps are formulated in order to make best use of them. The most involved method of exposing students to thematic mapping, and probably the best method, is to have students make thematic maps. An instructor may present a series of lectures on the concepts of thematic mapping, but until students make their first map, the concepts are abstract.

During the laboratory-discussion sessions students select topics that they wish to map. Usually, the topics relate to contemporary problems. They formulate themes about their topics and search the data banks for variables which might be used to present their themes. Next, they go to the library to read and attempt to analyze the definition of their variable and to determine how the data for the variable was collected.

After selecting the theme and the variable, the student must decide the type of mapping technique to employ. The symbol map is used to show point type data, the choropleth map to show area data, and the isopleth map to show volume data. Often students try all three mapping techniques on the same variable in order to compare the techniques. As the different mapping techniques are being inspected, students are also making exploratory maps of their variables. How a long series of numbers might be spatially distributed on a map is difficult for most students to visualize; hence, the need for exploratory maps. They might find from these maps that their theme is not supported by their variable, which means either the re-examination of their theme or selection of a different variable.

With themes determined and data selected, the students now decide the number and intervals of map categories, symbol patterns, and title and source. Here again they might make a series of maps investigating the consequences of their decisions. Once they complete their final map, they write a report indicating the theme of their map and the difficulties they encountered. The final map and report are given to the instructor for grading.

The instructor throughout the project warns the students that they might develop a good map in terms of communicating their theme, but that does not make their theme valid in terms of the real situation. The thematic map is used to synthesize and to communicate information

and ideas based on their decisions. The validity of their decisions must rest on other evidence.

Success

Based on interviews and examination performance of over 120 students during the past year, the objective of this instructional system with the strong assistance of the computer has been met and has been successful. Students have a much better understanding of thematic maps and the decision making process behind maps. Some students wish to use the system in other courses and have talked about making computer atlases. Two students enrolled in an advanced course on computer mapping that was offered by the author with the hope of getting jobs with planning firms producing computer maps.

Based on the success of this instructional system, it is being expanded so that students in advanced courses will be able to use it to produce maps for class projects or term papers. Another module is being planned for the system which will permit students to retrieve data from the data banks to use in statistical programs. Also, an effort is being made to acquire a digital plotter so that other types of maps can be produced.